A PARTICIPATORY METHOD TO DESIGN INNOVATIVE SUSTAINABLE CROPPING SYSTEMS FOR CITRUS PRODUCTION AT THE FIELD SCALE IN THE FRENCH WEST INDIES

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INTRODUCTION

Designing innovative sustainable cropping systems requires from agronomists a comprehensive approach of both agricultural practices and agro-ecosystems. Design and evaluation are often strongly linked in the process and are generally used repeatedly to form interactive loops of progress. Authors generally agree in identifying different steps in the design/evaluation process. The first step aims at diagnosing the production system constraints. The second step consists in the elaboration of the prototypes (Vereijken, 1997) and the co-construction of assessment indicators (Sadok et al., 2008). The third step evaluates and adjusts these prototypes while the last step assesses and validates them at the farm scale. Their adoption by farmers always requires a close collaboration between farmers and researchers from the beginning (Cloquell-Ballester *et al*. 2005) and moreover the integration of social, economic and environmental constraints, the different stakeholders' interests, and the consumers' demands. In recent years, the environmental impacts of agricultural productions have been regularly denounced by the society. A participatory method based on these principles and preoccupations was set up to build innovative citrus cropping systems in the Caribbean with lower chemical inputs.

MATERIALS AND METHODS

Our methodology (see figure) includes two main steps based on the results of an environmental assessment of the impact of farming practices (diagnosis phase). The method was applied on 41 farms that included citrus cropping systems in Guadeloupe (16° N 61° W). Farmer's practices were compared with a reference cropping system using assessment indicators (Boullenger et al., 2008). It allowed i) the identification of the system constraints and their determinants, ii) the definition of a reference cropping system including constraints (RCS) to designing an innovative cropping system (ICS). Step 1 of the method consisted in building up and evaluating cropping system prototypes in a field experiment. These prototypes were built thanks to technical discussions with the producers and redefined with a group of 3 farmers. At the same time, an expert group, composed of citrus chain stakeholders (consumers, government technical staff…), contributed to the determination of indicators set to assess the performances of ICS. Step 2 consisted in the prototypes validation by the expert and stakeholder groups in a network of experimental farms. Best prototypes became ICS. Finally, the redesign process of this method allowed ICS to become RCS and followed the same improvement process from step 1 as long as new constraints emerged.

RESULTS AND DISCUSSION

The overuse of pesticides in citrus farm was shown to depend on 2 major constraints: weed management and *Diaprepes* spp. control. *Diaprepes spp.* is a major pest for young citrus trees in Guadeloupe, but biological control has been proved efficient (Mailloux *et al*., 2009) and was integrated in the prototype

construction. Weed control was crucial particularly in areas where mechanization of orchards was not possible. At step 1, 5 cropping system prototypes were tested to fit with these constraints. Two are considered as reference cropping systems of current producers' practices. Prototypes were then adjusted according to iterative loops of production/assessment/improvement when innovative practices were introduced by researchers and an actor group of farmers. Ten performance indicators have been constructed according to the 3 pillars of sustainability (social, economic and environmental) for an *ex post* assessment. The validation of the prototypes is currently underway. First results show reductions of herbicide use by a 3 factor. Next step will allow the evaluation of ICS in comparison to RCS with our indicators in a network of pilot farms. The time step along the perennial cropping systems limits the possibilities for frequent innovation. Our method allows gradual changes in farming practices along with the stakeholders' demands. This participatory characteristic is essential to limit error.

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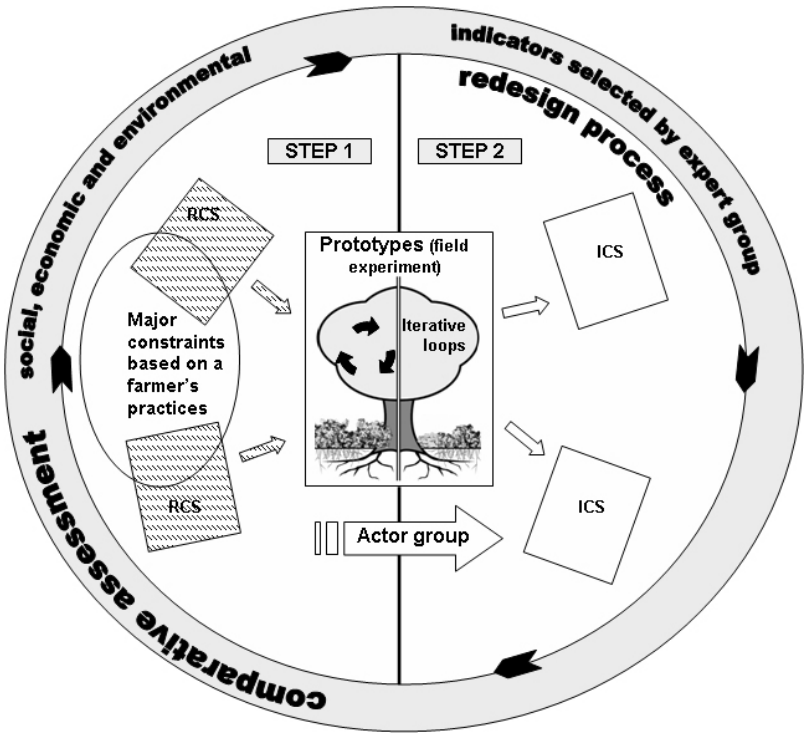

Figure: **Participatory method to redesign and to assess innovative sustainable cropping systems for citrus production. RCS**: Reference cropping system, **ICS**: innovative cropping system, **Actor group** composed of farmers, **Expert group** composed of citrus chain stakeholders, **Step 1** consists in building up and evaluating cropping system prototypes, based on a farmer's practices. **Step 2** consists in validating the prototypes in a network of experimental farms. **Redesign process**: ICS becomes RCS and follows the same improvement process as for step 1.